

TAXONOMY OF UNGULATES OF THE INDIAN SUBCONTINENT

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The ungulates of the Indian Subcontinent are remarkably diverse taxonomically and, despite their conspicuous nature, much remains to be learned about them. Their diversity appears to have been considerably underestimated, at both specific and subspecific level. Here, I argue that in historic times the Subcontinent has been home to 46 ungulate species. Three of these species (*Equus hemionus*, *Rhinoceros sondaicus* and *Bos javanicus*) are probably extinct. Six taxa, commonly regarded as subspecies of other species, I here raise to specific rank, or have done so very recently elsewhere: *Equus khur*, *Moschus cupreus*, *Muntiacus vaginalis*, *Cervus wallichii*, *Cervus hanglu* and *Capricornis thar*. Twenty-four species are polytypic; of these, eight are more widespread species represented by a single Subcontinental subspecies, but the remaining 16 show subspecific diversity within the Subcontinent itself. I describe one new subspecies, *Gazella bennettii salinarum*, and recognise three subspecies (for which names already exist) in *Tetracerus quadricornis*, a species previously thought to be monotypic.

INTRODUCTION

Over the hundred plus years of its existence, the Bombay Natural History Society has seen vast changes in its political and social setting, its clientele and its very rationale for existence. It has survived the demise of shikar and of British India, the dismembering of the polity that nurtured it, and even the change of name of the city that forms its base. In the meantime, the *Journal* of the BNHS has progressed from being a vehicle for documenting the fauna and flora of the Indian Subcontinent to its present status as the premier voice for knowledge, understanding and conservation of the Subcontinent's wildlife, both nationally and internationally.

In the midst of all these changes, we should not assume that the Society's original mission, that of documenting the fauna and flora of the Subcontinent, is complete. There is much to be learned, as I hope to show, about even the largest species of fauna, the ungulates. Again,

while the original three countries of the Subcontinent (India, Nepal and Bhutan) have become divided into six, with the creation first of Pakistan and Sri Lanka and later of Bangladesh, these six countries share a common wildlife heritage, and I treat them together here.

The object of this centennial contribution, then, is to gather together information on the taxonomy of the ungulates of the Subcontinent, and to try to document exactly what it is that we know or do not know about this small but important corner of its biodiversity.

TAXONOMY

Taxonomy, the science of biological classification, is still undergoing a wide-ranging rethink of its basic premises. A classification is an "information retrieval system", but exactly what information is it that we want to retrieve? Most practising taxonomists today would say that they want to try and incorporate information about evolution into their classifications, because this allows us to make predictions: if certain taxa share a common ancestor, their behaviours, their ecology and other aspects of their biology will be

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modifications of those of this ancestor. About how we might incorporate evolutionary information, however, there is as yet no consensus, although it can be argued that a new one is emerging.

Genera and higher categories: It is by now widely accepted that taxa of the genus-group and above should represent phyletic lineages. To place species A and B in one genus, and C in another, is to say that A and B share a common ancestor which is not shared by C.

The remaining controversy concerns how we should decide what ranks we should use. At present, this is purely arbitrary, often based on no more than tradition. Goodman *et al.* (1998), in the context of Primate taxonomy, have proposed to link taxonomic rank with time since divergence, and recently Groves (2001), citing some data on fossil ungulates, suggested slight modifications to this. A genus, in this scheme, would have a time depth of about 4-8 million years, a family, of 18-24 million. Subfamilies, tribes and subtribes would remain categories of convenience, as would subgenera: they would be used if subdivisions were needed, regardless of the exact times.

The Goodman *et al.* (1998) proposals are well worth considering; they would bring a much-needed objectivity into higher-category taxonomy. For the moment, however, we need more information on splitting times of lineages; this is a task for the future, and in what follows I have not made any drastic proposals for altering conventional genera.

Species: It is generally not possible to apply the well-known Biological Species Concept, whereby species are defined as being reproductively isolated. If two populations are sympatric and do not interbreed, this is of course unassailable evidence that they are different species; but what if they are allopatric, as closely related populations usually are? There is in this case no objective criterion beyond the opinion of some "expert" of whether they would or would

not be likely to interbreed if their ranges were to meet.

Many taxonomists now adopt the Phylogenetic Species Concept, whereby species are defined as being diagnosably different: that is to say, that every individual can be differentiated on at least one heritable feature (see Groves 2001). This substitutes 'genetically isolated' for 'reproductively isolated', and switches the focus to the pattern (which we can observe) and away from the process (which we can only infer, and which may have brought it about). Under this concept, some species are recognised that have hitherto been regarded as only subspecies: a small price to pay, one might say, for objectivity. In what follows, application of this fresh view of species has led to a drastic revision of species boundaries in *Equus*, *Cervus*, *Capricornis* and *Nemorhaedus*.

Subspecies: Some taxonomists do not think it worthwhile recognising subspecies: two populations are either diagnosably distinct, in which case they are different species, or they are not. Yet I think there is still value in distinguishing two populations which are different as a whole, but do overlap to some extent. Their gene pools are distinct, and they are of conservation concern (for example).

Exactly how distinct should their gene-pools be to merit subspecific rank? We must not try to be too rigid about this; the rule that says that 75% of individuals of one subspecies must be distinguishable from all individuals of other subspecies (the 75% rule) is a good guideline. We can say no more than that.

It is mandatory, of course, that subspecies be geographic segments of a species. The category should not be misused to designate conspicuous morphs (colour, karyotype, etc.) that occur within populations.

Synonymy: Among junior synonyms, only those described for the Subcontinent are listed here. Author, date and type locality, but not full bibliographic reference, are given.

Order Proboscidea
Elephants

FAMILY ELEPHANTIDAE

Genus *Elephas* Linnaeus, 1758

Elephas maximus Linnaeus, 1758. Asian elephant

Elephas maximus maximus Linnaeus, 1758.

1758 *Elephas maximus* Linnaeus. "In Zeylonae paludosis ad amnes" (in the marshes of Ceylon by rivers). Restricted to rain forests of Sabaragamuva by Deraniyagala (1939).

1797 *Elephas indicus* G. Cuvier. Deraniyagala (1955) states that this was based on a specimen from Ceylon (Sri Lanka), but an examination of Cuvier's description does not bear this out.

1797 *Elephas asiaticus* Blumenbach. Asia, chiefly Ceylon.

1845 *Elephas indicus bengalensis* de Blainville. Ganges in Bengal.

1845 *Elephas indicus ceylanicus* de Blainville. Ceylon.

1940 *Elephas maximus vilaliya* Deraniyagala. Manampitiya, floodplain of Mahavili, eastern Ceylon.

1950 *Elephas maximus dakhunensis* Deraniyagala. Travancore.

Deraniyagala (1955) distinguished two subspecies in Sri Lanka and two on the mainland of the Subcontinent. *Elephas maximus vilaliya*, which he calls the giant Ceylon swamp elephant, is restricted to the Mahavili floodplain, and is distinguished from the smaller nominotypical *E.m. maximus*, which is the widespread form, by its larger size and associated skull shape differences. The food supply on the Mahavili floodplain is exceptional; one must be cautious about recognising a separate subspecies based almost entirely on size and size-dependant features under circumstances where phenotypic plasticity is so likely to be involved. Sri Lankan

elephants differ from Indian in their general tusklessness, as male Indian elephants generally have tusks (see next para). Most Sri Lankan elephants are rather small, but Mahavili ones can be larger than mainland ones.

Deraniyagala's mainland subspecies were differentiated on the basis of tusk development and the degree of depigmentation on the ears and face. In *E.m. dakhunensis* 96% of the males are tusked, and depigmentation is "heavy and white", but in *E.m. bengalensis* only 51% of males have tusks, and depigmentation is "scanty and white"; in Southeast Asian subspecies over 90% of males are tusked, and depigmentation is scantier and grayer (less white) the further south one goes.

The information on the proportion of tusked males is interesting but cannot be of much value for differentiating subspecies, given that it concerns males only and the percentage differences are so slight (nowhere near the 'seventy-five percent rule' described above). The amount of depigmentation may be more cogent. All Asian elephants undergo some facial and ear depigmentation with age, and it is, in my experience, notably heavier at any age in Indian than in Southeast Asian elephants, but there is a great deal of overlap between northern and southern Subcontinent elephants. For the moment, no subspecies are recognised in the region, though Indonesian/Malaysian (*E.m. sumatranus*) and probably mainland Southeast Asian (*E.m. birmanicus*) subspecies would be worth recognising at least provisionally.

Order Sirenia
Seacows

FAMILY DUGONGIDAE

Genus *Dugong* Lacépède, 1799

Dugong dugon (Müller, 1776). Dugong
1776 *Trichecus dugon* Müller. Cape of Good Hope to Philippines.

1799 *Dugong indicus* Lacépède. Indian Ocean.

There appears to be no study to examine whether any geographic differentiation exists between Red Sea, Indian Ocean and Australasian dugongs.

Order Perissodactyla
Odd-toed ungulates

FAMILY EQUIDAE

Genus *Equus* Linnaeus, 1758

Equus kiang Moorcroft, 1841. Kiang or Tibetan wild ass

The kiang has a large head and thick muzzle; relatively long mane; and long hairs not restricted to tail tuft but extending some way up either side of tail. The demarcation pattern between contrasting dark (reddish) body blocks and white underside is oblique from stifle (knee joint) to croup (rump), and the white rump patch is infused with the reddish tone of the haunch. The dorsal stripe is thin and never bordered with white; it extends to tail tuft. A dark ring round hoof. Ear 165-178 mm long.

Skull resembles *E. hemionus*, except that incisors tend to sit more vertically in the jaws (except in aged individuals, in which alveolar recession tends to reveal the oblique roots), and highest point on cranial profile is often directly above the posterior rim of the orbit, instead of behind it.

Equus kiang kiang Moorcroft, 1841

1841 *Equus kiang* Moorcroft. Eastern parts of Ladakh.

Size large, skull length 492-537 mm (n=15). Range in Subcontinent: Ladakh.

Equus kiang polyodon (Hodgson, 1847)

1847 *Asinus polyodon* Hodgson. Tibet, just north of the Sikkim border (fixed by Groves and Mazák, 1967).

1959 *Hemionus kiang nepalensis* Trumler. "Nepal"; more probably the region of Tibet just north of the Sikkim border (see Groves and Mazák, 1967, who discuss the status of the skin and skull of the type specimen).

Size very small, skull length 473-494 mm (n=7), but nasals and toothrow as long as in other kiangs. Range in Subcontinent: Sikkim.

Equus hemionus Pallas, 1775. Onager or Asian wild ass

Mane very short, "clipped"; dorsal stripe thick, bordered with a white line on either side; white of rump is not infused; demarcation between the reddish flank block and whitish underside runs parallel to the body outline, before turning sharply up towards the dorsal stripe. A dark ring round hoof. Nasal bones relatively straight. Skull resembles *E. kiang*.

Equus hemionus blanfordi (Pocock, 1947)

1947 *Microhippus hemionus blanfordi* Pocock. Sham Plains, Quetta, Baluchistan.

This grayish subspecies was unusual in *E. hemionus* in that the dorsal stripe did not reach the tail-tuft. Skull length 484-498 mm (n=2). It is now extinct; I have seen only two specimens, one from the type locality, and the other from Kandahar in Afghanistan.

Equus khur Lesson, 1827. Khur or Indian wild ass

1827 *Equus khur* Lesson. Little Rann of Kutch (fixed by Groves and Mazák, 1967).

1862 *Asinus indicus* George, 1869. India.

The khur is sharply distinct from *Equus hemionus*, and we cannot now tell whether the two intergraded; at any rate, the extinct Baluchistan subspecies of *E. hemionus* (see above) was not intermediate, except possibly in the failure of the dorsal stripe to extend to the tail-tuft. In *Equus khur* the coloured blocks on flank and haunch are very small, so the predominant colour is white, and lower 45% or more of flank is

whitish; demarcation on the lower haunch slants upward from front (stifle) to back. Dorsal stripe with a clear white border on either side; this becomes obfuscated with age, but probably never entirely disappears. White wedge between haunch- and flank-blocks nearly or fully reaches spine. Legs pure white. White zone on muzzle occupies nearly 40% of snout-to-ear distance. Dorsal stripe fades out halfway down tail. No dark ring round hoof. Nasal bones raised (making whole facial profile strongly concave); skull short [length, male 493-519 mm (n=3), female 468-511 mm (n=6)], with small teeth, noticeably high-crowned. Choanae small. Orbits high. Metapodials less elongated than *E. hemionus*. Ear very long, 187-210 mm.

The khur still occurs in the Little Rann of Kutch. I have seen a specimen from Thar Parkur, Sind, where it is now extinct.

FAMILY RHINOCEROTIDAE

Genus *Rhinoceros* Linnaeus, 1758

Rhinoceros unicornis Linnaeus, 1758. Indian/ Great one-horned rhinoceros

1758 *Rhinoceros unicornis* Linnaeus, 1758. Rookmaaker (1998) shows that this name was based on the same specimen from which Albrecht Dürer's famous woodcut was taken. He suggests restricting the type locality to Assam.

1817 *Rhinoceros indicus* G. Cuvier.

1830 *Rhinoceros asiaticus* Blumenbach.

1867 *Rhinoceros stenocephalus* Gray. Asia.

1876 *Rhinoceros jamrachi* Sclater. Manipur. Contra Rookmaaker (1983), I would consider that the original description, that of Jamrach (1874), does not truly count as a "publication."

The historical distribution of this species extended from the upper Brahmaputra, on (and beyond) the Burmese border, along the Ganga-Brahmaputra system to the Indus and its

tributaries, as far west as the Khyber Pass (Rookmaaker 1980, Rookmaaker 2000).

In the multivariate analysis of Groves (1993a), Nepalese and Assamese skulls are different. Those from Assam tend to have narrower zygomatic breadth but wider occiput and interorbital region. A single skull from Koch Bihar was more similar to those from Nepal. These findings should be tested on larger samples.

Rhinoceros sondaicus Desmarest, 1822. Javan/ Lesser one-horned rhinoceros

Rhinoceros sondaicus inermis (Lesson, 1840)

1840 *Rhinoceros inermis* Lesson. Sunderbans.

Broad across the zygomatic arches, and high occiput (Groves and Chakraborty 1983, Groves 1993a). The subspecies from the Sunderbans and neighbouring districts (including the Sylhet and Chittagong districts of Bangladesh, and Manipur, possibly also Bhutan and Sikkim: see Rookmaaker 1980) became extinct in the 1890s.

A skull from Moraghat, Bhutan Duars (where the species has been extinct since the 1870s), differs slightly from Sunderbans specimens, especially in its large teeth (Groves 1967).

Genus *Dicerorhinus* Gloger, 1841

Dicerorhinus sumatrensis (G. Fischer, 1814). Sumatran/Asian two-horned rhinoceros

Dicerorhinus sumatrensis lasiotis (Sclater, 1872)

1872 *Rhinoceros lasiotis* Sclater. Chittagong.

A large subspecies with large teeth and very broad, high occiput; molar teeth are large (Groves and Chakraborty 1983, Groves 1993a). Formerly occurred in the northeastern states of India and eastern Bangladesh, as far west as the Sankosh river, and North Cachar, Cachar and Hailakandi districts in Assam; it apparently still occurs in Manipur and Nagaland (Choudhury 1997).

Order Artiodactyla
Even-toed ungulates

FAMILY SUIDAE

Genus *Sus* Linnaeus, 1758

Sus scrofa Linnaeus, 1758. Eurasian wild pig (Indian wild boar of Prater, 1971)

Sus scrofa cristatus Wagner, 1839

1839 *Sus cristatus* Wagner. Near Calcutta (fixed by Groves, 1981).

1868 *Sus aper* var. *aipomus* Gray. Nepal. After a *nomen nudum* of Hodgson (1842).

1868 *Sus aper* var. *isonotus* Gray. Nepal. After a *nomen nudum* of Hodgson (1842).

1843 *Sus indicus* Gray. Nepal (fixed by Groves, 1981).

1847 *Sus affinis* Gray. Nilgiri Hills.

1851 *Sus zeylonensis* Blyth. Ceylon.

1860 *Sus bengalensis* Blyth. Bengal and Kutak.

Skull large (skull lengths of males in different populations average from 379 mm in Nepal to 414 mm in southern India), broad and high-crowned; mainly black, brindled with white, with a long mane all along the back. From the sub-Himalayan tract, from Punjab east to Nagaland, and south to Bihar, Madhya Pradesh and Kolhapur, Maharashtra.

Groves (1981) recognised a southern Indian and Sri Lankan subspecies, *Sus scrofa affinis*, but this differs from *S.s. cristatus* only in its larger size, and considering the known environmentally induced plasticity of size in pigs, the inference that the difference is genetic cannot be sustained. In addition, the wide variation in size in Sri Lanka covers both Indian "subspecies", and more.

Sus scrofa davidi Groves, 1981

1981 *Sus scrofa davidi* Groves. Sind.

A small-sized subspecies (adult males average 365 mm), with a low-crowned skull; colour light brown or yellowish, with long thick mane.

From the dry country of northwestern India (Pune, Gujarat, Rajasthan) and Pakistan (Sind).

Sus salvanius (Hodgson, 1847). Pygmy hog

1847 *Porcula salvania* Hodgson. Sikkim Terai.

1863 *Sus lilliputensis* Gray. *Nomen nudum*.

A tiny species, shoulder height 230-305 mm in males, 200-216 mm in females. Dark brown with subterminal light hair bands, no mane, very short tail, and relatively long hindlegs compared to forelegs. The inner "false hoofs" are short compared to other pigs. A detailed description is given by Ghosh (1988), who supports restoring the genus *Porcula* Hodgson, 1847, for this species. Known in the past from the grass jungles of eastern Nepal, Sikkim, northern Bengal, Bhutan and western Assam; now known for certain only from Assam.

FAMILY TRAGULIDAE

Genus *Moschiola* Hodgson, 1843

Moschiola meminna (Erxleben, 1777). Indian chevrotain or Mouse-deer

1777 *Moschus meminna* Erxleben. Ceylon.

1842 *Tragulus mimenoides* Hodgson. Nepal Terai.

1843 *Meminna indica* Gray. Renaming of *meminna*.

1843 *Meminna malaccensis* Gray. Supposedly from Singapore.

The Indian mouse-deer, which lives in Sri Lanka, southern India and Nepal, has been poorly studied taxonomically, in contrast to the related Southeast Asian genus *Tragulus* in which dozens of subspecies have been described.

FAMILY MOSCHIDAE

Genus *Moschus* Linnaeus, 1758

According to the latest revision (Groves *et al.* 1995), four species of musk deer occur in the Subcontinent; three of these (the exception being

Moschus cupreus) extend into Sichuan and Yunnan, in China. Some new subspecies remain to be described in *M. leucogaster*; these may possibly prove to be distinct species. All species live at about 2,500 to 4,200 m above msl, in the Alpine zone. The undescribed species inhabiting Uttar Pradesh (areas now in Uttaranchal), Himachal Pradesh and western Nepal apparently lives in high-altitude forest at 2,500 to 3,000 m. The ecological differentiation between the two overlapping species of the Himalayan slopes, *M. leucogaster* and *M. fuscus*, is unclear. The Subcontinent has no lower-altitude species restricted to the lower montane forest zone, analogous to *M. berezovskii* of China.

***Moschus chrysogaster* Hodgson, 1839.** Alpine/Golden-bellied musk deer

1839 *Moschus chrysogaster* Hodgson. "Nepal": probably from the Tibetan plateau.

1915 *Moschus cacharensis* Lydekker.

From eastern Nepal, Sikkim and Bhutan, entirely in the plateau zone, above the tree-line. Dark brown, intensely speckled with buff to golden ochre. Throat with a noticeable pair of yellowish longitudinal stripes or spot-rows; rump yellowish, paler than back; ears dark brown, speckled buff, outside, with pale tips; orange-ochrey inside and at base. Limbs becoming paler distally, until shanks are whitish. Underside paler, often yellowish; an orange eye-ring. Large size: metacarpal length 109-118 mm, metatarsal 128-138 mm. Hoofs are more elongated than other species, 27-29 mm (in other species, 24 mm).

***Moschus leucogaster* Hodgson, 1839.** White-bellied musk deer

1839 *Moschus leucogaster* Hodgson. "Nepal," probably from the Himalayan slopes.

1839 *Moschus saturatus* Hodgson. "Nepal," probably from the Himalayan slopes.

Eastern Nepal, Sikkim and Bhutan, on the Himalayan slopes. Dark brown to agouti red

above, with a yellowish tone on buttocks; belly pale grey; throat wholly whitish, or with a white sternal patch; limbs dark externally, with white speckling on inner surfaces and often on digits. Ears blackish, with very fine whitish speckling except at the tip which is wholly dark. Size large like *M. chrysogaster*.

***Moschus* sp.** Kulu/Indian forest musk deer

The musk deer from Uttaranchal (erstwhile Uttar Pradesh) and Himachal Pradesh (Garhwal, Tehri, Chamba, Kulu, Kedarnath, Barinda Pass, Jaunsar) and western Nepal (as far east as Mustang) may be specifically distinct. Grubb (1982) cites field evidence from M.J.B. Green, R.M. Mitchell and others that there may be geographic overlap, with some elevational difference between light and dark musk deer, within Nepal, the grey ones being found in dense oak/rhododendron forests. Colour is pale grey, with at most a poorly defined browner, speckled saddle area; ears are bordered with white; the rump is entirely dark; the belly is white.

***Moschus fuscus* Li, 1981.** Dwarf musk deer

From Assam west to the Mount Everest region of Nepal, again on the Himalayan slopes. Colour very dark above and below, the head, ears and legs being black, neck often lighter; throat dark often with two incomplete yellow "collars"; rump with ochrey tones, but black on buttocks. The smallest species: skull length less than 150 mm, nasals under 46 mm; metacarpal length 88-101 mm, metatarsal 126-135 mm.

***Moschus cupreus* Grubb, 1982.** Kashmir musk deer

From Kashmir, at over 3,000 m above msl. Colour grey-brown, often vaguely spotted, with a coppery-reddish dorsal saddle; rump dark, grizzled grey; underside light grey; throat white; lower segments of limbs whitish. Ears dark brown, white at base, with frosted rims. Large species.

FAMILY CERVIDAE

Genus *Muntiacus* Rafinesque, 1815

Muntiacus vaginalis (Boddaert, 1785). Red/Indian muntjac or Barking deer

Though conventionally placed in a single species, the red muntjac should preferably be split into at least two. Differences are marked and consistent, and their different karyotypes should reduce the fertility of hybrids between them (although one possible wild hybrid was described by Groves and Grubb, 1990). The present species, found in suitable country throughout South Asia and mainland Southeast Asia north of the Isthmus of Kra, differs from Indonesian/Malaysian *M. muntjak* in its chromosome number ($2n = 6$ in the female, 7 in the male, vs $2n = 8$ in the female, 9 in the male of *M. muntjak*), and in the relative lack of contrasts in colour, especially the absence of the median dorsal darkening of *M. muntjak*. The black-legged muntjac of the southern borders of China and neighbouring regions may constitute a third species of the red muntjac group.

Descriptions of subspecies are after Groves and Grubb (1990).

Muntiacus vaginalis vaginalis (Boddaert, 1785)

1785 *Cervus vaginalis* Boddaert. Bengal.

1827 *Cervus moschatus* Hamilton Smith. Not of de Blainville, 1816 (= *M. muntjak*).

1833 *Cervus ratwa* Hodgson. Nepal.

1840 *Cervus melas* Ogilby. Himalayas.

1845 *Cervus styloceros* Schinz. Renaming of *melas*.

Dark reddish dorsally, somewhat paler on flanks; nape slightly greyer; forehead and occiput light orange-brown, rest of face grayish; ear-backs reddish at base, remainder dark grey; limbs dark brown to grey; underside paler; groin and line on front of hindlegs, to hocks, white. Largest of the three subspecies of the Subcontinent, averaging about 200 mm skull length. Antlers 80-120 mm long; pedicels relatively long, averaging 125 mm. From Shevaroy Hills north to Nepal and Bhutan.

Muntiacus vaginalis aureus (Hamilton Smith, 1826)
1826 *Cervus aureus* Hamilton Smith. Some part of southern India.

?1844 *Cervus albipes* Wagner. Supposedly from Bombay and Poona. This name may actually be a senior synonym of *malabaricus*.

1872 *Cervus tamulicus* Gray. Deccan.

Pale yellowish on body and limbs; nape greyer; forehead and occiput pale orange-brown, rest of face light orange; ear-backs orange at base, becoming grey, and tips and rims may be dark grey; underside paler; a line on front of hindlegs, to hocks, white. Medium sized, skull length averaging 192 mm. Antlers short, 70-100 mm, pedicels about 110 mm. From Kumaun and Kheri, southeast to the Deccan.

Muntiacus vaginalis malabaricus Lydekker, 1915

1915 *Muntiacus muntjak malabaricus* Lydekker. Nagarhole.

Colour of body and limbs a washed-out reddish, with much greying on nape and back; underside drab; white area on inner and lower limb segments extending round to front of pasterns, restricting red to a narrow anterior band. Small, skull length averaging 178 mm. Antlers short, 60-100 mm, with short pedicels, only 100 mm. From Sri Lanka and southern India northwest as far as Pune.

Genus *Cervus* Linnaeus, 1758

This genus has usually been taken to include, as subgenera or species-groups, *Rusa* and *Rucervus* (and sometimes also *Axis* and *Hyelaphus*). Groves and Grubb (1987) pointed out that *Elaphurus* is the sister-group of *Cervus* s.s. (=sensu stricto), so if *Elaphurus* — a widely recognised genus — is to be retained, to preserve the monophyly of *Cervus* it is necessary to keep *Axis*, at the very least, separate (they included *Hyelaphus* in *Axis*); and, according to the arguments of Grubb (1990) and Geist (1998), *Rusa* and *Rucervus* should also be recognised as valid genera for the same reason.

The genus, thus restricted, has traditionally been considered to contain two species: *Cervus elaphus* (red deer, wapiti, shou, Kashmir stag) and *C. nippon* (the sika, of Japan and China). Geist (1998), however, has considered the interrelationships of the "elaphine deer" in some detail, and stressed the consistent differences in both morphology and behaviour between red deer and wapiti, which he clearly regards as distinct species (*Cervus elaphus* and *C. canadensis* respectively). Information on other elaphine deer is not adequate to determine their taxonomic status so clearly, but the two taxa from the Subcontinent are neither wapiti nor true red deer, though perhaps closer to wapiti. They belong to what Geist regards as the "primitive group", whose antlers are characterised by the bez tine being larger than the brow tine and by having a sharp bend at the 3rd tine (like wapiti in both characters), while retaining a primitive 5-tined plan; extra branching occurs in well-developed antlers, as is characteristic of all elaphine deer, but in these primitive taxa it takes the form of a transverse branching of the 4th tine, and occasionally of the 5th as well.

In these primitive elaphines, as Geist shows, no special summer coat is grown, so in summer they are just a faded version of the winter colour. Their small rump patches and short manes are also primitive, yet the very short tail, only half as long as the ear, is an advanced feature.

The rutting call, which is so different in wapiti and red deer, is different again in the primitive group. It begins in red deer fashion, with a closed-lips roar, then opens out as the lips are retracted to end in a wapiti-like bugle. Geist sees the group as adapted to saltatorial running on steep slopes in high mountain forests and among shrubs.

There is no sense in attempting to keep these primitive elaphines in the same species as wapiti, with which they admittedly share a few primitive retentions; still less as in the same species as red deer. Their primitive features are

shared with a third taxon, *macneilli* from Sichuan. They nonetheless differ consistently from each other, and the radical step of regarding them as separate species seems unavoidable. Excellent colour photographs of them can be seen in Dolan (1988).

Cervus wallichii G. Cuvier, 1823. Shou

1823 *Cervus wallichii* G. Cuvier. Nepal; restricted to Mansarowar Lake, Tibet, by Lydekker (1915).

1841 *Cervus affinis* Hodgson. Supposedly from Sal Forest, Nepal, but more likely from Sikkim.

1850 *Cervus tibetanus* Hodgson. Lingmo, Phari, Dingcham, Tibet.

1851 *Cervus nariyanus* Hodgson. Western Tibet.

These are, according to Geist (1998), short-legged, broad-hoofed deer with long narrow ears and a large square muzzle. In winter, light sandy brown with a grey face, in summer fading to slate-grey. The large white rump patch extends upward on the croup and surrounds the short, white tail, and is sometimes partially divided by a very weakly-marked median line of the body colour; there may be a blackish edging infero-laterally. Chin and lips are grey or fawn; belly and inner surfaces of hindlegs grey. The short mane is the same colour as the body. Skull length of stags 432-481 mm (n=10); antler length (straight) of prime stags 800-1,040 (n=8), brow tine length 272-368 mm; the tip of the beam is longer than the 4th tine.

This species occurred in Sikkim on the Tibetan frontier (Chumbi Valley), and still occurs in Bhutan (Dolan 1988). It is uncertain whether the Tibetan (Upper Tsangpo) population (true *wallichii*) is the same as that of the Chumbi Valley (*affinis*), but it seems likely that the features of the rump patch, the only described difference, are variable.

Cervus hanglu Wagner, 1844. Kashmir stag

1844 *Cervus hanglu* Wagner. Kashmir.

1847 *Cervus casperianus* Gray. Kashmir.

1859 *Cervus cashmeriensis* Adams. Kashmir.

In winter, dark liver-brown, the legs and chest rather darker, and the face, neck and back usually lighter; in summer, fading to a relatively light tone with a sharply contrasting dark chest and limbs. Many females are spotted in summer. The narrow rump patch does not extend, or hardly extends beyond the tail root, is invaded by a wedge of body colour which may extend onto the tail, and is bordered infero-laterally by a black band. Chin, lips and inside of ears are white; belly, groin and inner surfaces of hindlegs whitish; a dark area on posterior belly. The metatarsal gland is creamy to light red. There is dark curly hair between the antler pedicels. Smaller than *Cervus wallichii*: skull length of stags 359-415 mm (n=8), but antlers relatively larger, straight length 752-1,053 mm (n=12), with shorter brow tine (229-315 mm); the tip of the beam is shorter or barely longer than the 4th tine. From the Vale of Kashmir and neighbouring regions, up to 3,600 m above msl; now restricted to Dachigam and Srinagar City Forest National Parks.

Genus *Rucervus* Hodgson, 1838

Regarded as a distinct genus, rather than a subgenus of *Cervus* or of *Rusa*, by Grubb (1990). The two species of the Subcontinent differ sharply in antler form, in the development of the lachrymal pit in the skull, and in the metatarsal tuft of *R. eldii*. However, they are clearly sister species, and the genus *Panolia*, erected for *R. eldii*, is not warranted.

Rucervus eldii (McClelland, 1842). Eld's/Brow-antlered deer

Rucervus eldii eldii (McClelland, 1842)

1842 *Cervus eldii* McClelland. Manipur.

1843 *Cervus frontalis* McClelland. Renaming of *eldii*.

1843 *Panolia acuticornis* Gray. Manipur.

1845 *Cervus lyratus* Schinz. Manipur.

1901 *Cervus eldi cornipes* Lydekker. Manipur.

A distinctive subspecies, differing from those in the Indo-Chinese region by its elongated, spreading hooves with bare, cornified skin on the backs of the pasterns. It is restricted to the masses of floating vegetation called 'phumdi', in Logtak Lake, Manipur, where there are still under a hundred individuals, though it breeds well in captivity.

Rucervus duvaucelii (G. Cuvier, 1823). Barasingha or Swamp deer

Rucervus duvaucelii duvaucelii (G. Cuvier, 1823)

1823 *Cervus duvaucelii* G. Cuvier. Northern India (restricted to Kumaun by Groves, 1983).

1834 *Cervus bahrainja* Hodgson. Nepal.

1835 *Cervus elaphoides* Hodgson. Substitute for *bahrainja*.

1837 *Cervus smithii* Gray. Northern India (restricted to Kumaun by Groves, 1983).

1843 *Cervus dimorphé* Hodgson. Sal forests of the Morung, Nepal.

1850 *Cervus euceros* or *euryceros* Gray. India (restricted to Kumaun by Groves, 1983).

1868 *Cervus eucladoceros* Falconer. West bank of Ganges, south of Hardwar, United Provinces.*

A swampy-ground form, with splayed hooves and naked pasterns. Antlers long, slender, not compressed or palmated. Short nasals, rostrum slender (not deep). Little size difference between sexes; tail long, slender; ears large, rounded, with thick white hair inside. From Kumaun, Kheri, and southwestern Nepal; formerly extended east to Chitwan.

Rucervus duvaucelii branderi Pocock, 1943

1943 *Rucervus duvaucelii branderi* Pocock. Mandla, Madhya Pradesh.

*area now in Uttaranchal

The hard-ground form, with "well-knit" feet and hair-covered pasterns. Body size smaller, with some sexual dimorphism, male with dark rutting pelage and prominent neck ruff; antlers very long, with long brow tine, many branches, branching high up the beam, with long anterior branch. Long nasals, short broad snout. Tail somewhat shorter; ears large, rounded, with thick white hair inside. Prominent white spots along dorsal stripe, especially during moult. Restricted to Kanha National Park.

Rucervus duvaucelii ranjitsinhi (Groves, 1983)
1983 *Cervus duvauceli ranjitsinhi* Groves.
Guwahati, Assam.

A swampy-ground subspecies with spreading hooves and bare pasterns. Long nasals, short snout, slender from side to side but deep. Antlers short, thick, branching low down, with short anterior branch, somewhat compressed and tending to be palmate. Heavily built, with females rather small. Tail short; ears small, pointed, without much white hair inside. White median dorsal spots not prominent. Assam.

Genus *Rusa* Hamilton Smith, 1827

Regarded as a distinct genus, rather than a subgenus of *Cervus*, by Grubb (1990).

Rusa unicolor (Kerr, 1792). Sambar (Sambur)

Rusa unicolor unicolor (Kerr, 1792)
1792 *Cervus axis unicolor* Kerr. Ceylon
(restricted by Hamilton Smith, 1827).
1792 *Cervus axis major* Kerr. Ceylon.
1799 *Cervus albicornis* Bechstein. Substitute
for *major*.
1816 *Cervus niger* de Blainville. North India
(restricted by Pocock).
1823 *Cervus aristotelis* G. Cuvier. Nepal.
1823 *Cervus leschenaulti* G. Cuvier. Coromandel.
1827 *Cervus hippelaphus* Hamilton Smith.
Bengal. Not of Erxleben (1777) = *Cervus*
elaphus.

1831 *Cervus jarai* Hodgson. Nepal.
1841 *Cervus heterocerus* Hodgson. Nepal.
1841 *Cervus nepalensis* Hodgson. Nepal.
1843 *Axis pennantii* Gray. India.

Antlers are relatively long, with short brow tines. The two terminal antler tines tend to form an equal fork, although this is variable; the relationship between their lengths is also variable, but the posteromedial tine is frequently the longer. From Sri Lanka and most of the mainland, except the far Northeast. Pocock (1943a) separated Sri Lankan and mainland sambar into different subspecies, an action described by Groves and Grubb (1987) as "based on scant evidence of a size difference" and, even were it fairly consistent, it would not be very convincing evidence for different subspecies, given the known environmental effects on body size among deer.

Rusa unicolor equina (G. Cuvier, 1823)

1823 *Cervus equinus* G. Cuvier. Sumatra.

Antlers are shorter, and brow tines are longer. The anterolateral tine always continues the line of the beam and is longer than the posteromedial tine. From the northeast of the Subcontinent; Pocock (1943a) mentions the Garo Hills.

Genus *Axis* Hamilton Smith, 1827

Axis axis (Erxleben, 1777). Chital or Spotted deer
1777 *Cervus axis* Erxleben. Banks of the Ganges.
1792 *Cervus axis maculates* Kerr. Banks of the
Ganges.
1829 *Cervus axis* var. *indicus* G. Fischer.
1829 *Cervus axis* var. *ceylonensis* G. Fischer.
Ceylon.
1831 *Cervus nudipalpebra* Ogilby. Banks of the
Ganges.
1842 *Axis major* Hodgson.
1842 *Axis minor* Hodgson.
1905 *Cervus (Rusa) axis zeylanicus* Lydekker.
Ceylon.

Pocock (1943b) did not admit the mainland and Sri Lankan populations as distinct subspecies.

Genus *Hyelaphus* Sundevall, 1846

This is usually placed as, at most, a subgenus of *Axis*, but Grubb (1990) regards it as a full genus, retaining the primitive antler plan of the *Cervus* group.

Hyelaphus porcinus (Zimmermann, 1780). Hog-deer

Hyelaphus porcinus porcinus (Zimmermann, 1780)
1780 *Cervus porcinus* Zimmermann, 1780.
Bengal.

1883 *Cervus minor* Sclater. India. Not of Hodgson (1842).

From Sind and the Ganga north into Uttar Pradesh (erstwhile United Provinces), Nepal and northeastern India.

Hyelaphus porcinus oryzus (Kelaart, 1852)
1852 *Axis oryzus* Kelaart. Ceylon.

Pocock (1943b) separated the Sri Lankan subspecies on the basis of being smaller, with poorly developed antlers, without spots in the adult and with no marked seasonal change in colour. He admitted that the Sri Lankan population might actually be introduced (and the absence of hog-deer from southern India gives pause for thought). Whether there are any valid genetically based differences between them should be tested by future research.

FAMILY BOVIDAE

Genus *Bos* Linnaeus, 1758

Bos gaurus Hamilton Smith, 1827. Gaur or Indian bison

In historic times, gaur occurred in Sri Lanka (Knox 1681). The name *guavera* Kerr, 1792, which

was based on Knox's description, was suppressed by the International Commission on Zoological Nomenclature (1985) in order to preserve the priority of the familiar name *gaurus*.

The subspecies as listed here, and the use of the name *laosensis* in place of the more familiar *readei* for the Southeast Asian subspecies, are based on a revision in preparation by Grubb and Groves.

Bos gaurus gaurus Hamilton Smith, 1827

1827 *Bos gaurus* Hamilton Smith. Mainpat, Sarguja Tributary States, India.

1827 *Bos gour* Hardwicke. Mountainous district of Ramgurh and tableland of "Sirgoojas."

1837 *Bibos subhemachalus* Hodgson. Sal Forests, Nepal.

1837 *Bibos cavifrons* Hodgson. Substitute for *subhemachalus*.

1842 *Bibos concavifrons* Roulin. Substitute for *cavifrons*.

1846 *Bos gaur* Sundevall. Substitute for *gaurus*.

1851 *Bos asseel* Horsfield. No locality.

Indian gaur are rather smaller (mean skull length of males, 542 mm) than Southeast Asian gaur, but with relatively longer nasal bones (222 mm) and wider occiput. Northern Indian gaur do not differ in size from the from the peninsular ones, but have a markedly narrower span across the horns in males (mean values are 795 mm in northern India, 846 mm in the south). The range of this subspecies reaches Nepal and Sikkim.

Bos gaurus laosensis (Heude, 1901)

1901 *Gauribos laosensis* Heude. Camoun, in the mountains separating Laos and Tonkin.

1903 *Bos gaurus readei* Lydekker. Myitkyina, Burma.

Skulls from Assam resemble Southeast Asian gaur. The Southeast Asian subspecies is larger than Indian gaur (skull length averages 587 mm in male), with relatively short nasals (mean 228 mm); and the occiput is narrower. The horn tips are less turned in relative to the horn span.

Specimens from Bhutan and Chittagong are intermediate between the two subspecies.

Bos javanicus d'Alton (1823). Banteng
1898 *Bos sondaicus birmanicus* Lydekker. Burma.

There have been constant reports of banteng in Manipur, but there is as yet no confirmation.

Bos mutus (Przewalski, 1883). Wild yak
1883 *Poephagus mutus* Przewalski. Western Nan Shan, Ganssu.
Yak enter Indian territory in Ladakh.

Bubalus arnee (Kerr, 1792). Wild buffalo or Arna
The subspecies of the Subcontinent, and their characters, are after Groves (1996). The question of whether the Sri Lankan wild buffaloes are wild or feral is unresolved.

Bubalus arnee arnee (Kerr, 1792)
1792 *Bos arnee* Kerr. Restricted to Kuch Behar by Harper (1940).
1807 *Bos arni* Blumenbach. Mountains of north Hindustan.
1852 *Bubalus arna* var. *macrocerus* Gray. After a *nomen nudum* of Hodgson (1841). "India" (probably Nepal).
1912 *Bubalus bubalus septentrionalis* Matschie. Kuckri-Muckri, an island in the Bay of Bengal, off the Sunderbans.

Formerly occurred from the Sunderbans into Nepal, Madhya Pradesh and Andhra Pradesh; still occurs in Raipur and Bastar districts (Madhya Pradesh) and Kosi Tappu Reserve (Nepal), but in very small numbers, probably less than 200. Skull length usually under 570 mm, horn span under 1,200 mm. Black, with contrasting white limbs below knees and hocks, and white muzzle; tail reaches down to hocks.

Bubalus arnee fulvus (Blanford, 1891)
1891 *Bos arnee fulvus* Blanford. Mishmi Hills. Brahmaputra Valley, formerly from Koch

Behar to Mishmi Hills and south to Chittagong Hills; still occurs sporadically along the Brahmaputra and in Manas (Choudhury 1997). Larger, skull length usually over 570 mm, horn span over 1,100 mm. Grey or brownish grey, and less contrastingly white on limbs; tail falls short of hocks.

Genus *Boselaphus* de Blainville, 1816

Boselaphus tragocamelus (Pallas, 1766). Nilgai
1766 *Antilope tragocamelus* Pallas. Plains of peninsular India.
1777 *Antilope albipes* Erxleben. India.
1777 *Antilope picta* Pallas. India.
1827 *Damalis risia* Hamilton Smith. Substitute for *picta*.
1837 *Tragelaphus hippelaphus* Ogilby. Substitute for *picta*.
1846 *Portax tragelaphus* Sundevall. Error for *tragocamelus*.

There is very little geographic variation in male nilgai skulls, from localities as far apart as Gir, Rajasthan, Bhopal, Kanpur and Patna. A skull from Bengal, however, is overall one of the smallest, with the shortest horns, but the widest in bizygomatic breadth [157 mm, cf. 131-148 mm (n=20) from other localities].

Genus *Tetracerus* Leach, 1825

Tetracerus quadricornis (de Blainville, 1816). Chowsingha or Four-horned antelope

Unlike the nilgai, the chowsingha has well-marked geographic variation, and we can distinguish three subspecies. The metric differences are given in Table 1.

Tetracerus quadricornis quadricornis (de Blainville, 1816)

1816 *Cerophorus (Cervicapra) quadricornis* de Blainville. Plains of peninsular India.
1825 *Antilope chickara* Hardwicke. Bengal, Bihar and Orissa.

1828 *Antilope tetracornis* Hodgson. No locality.

A relatively large form with narrow nasal bones. Four long horns. Colour yellow-fawn above, creamy or creamy-fawn below, this tone often confined to midline; forelimbs markedly blackened down anterior surface; median dorsal region darker than rest of upperside; tail long, with bushy white tip. Nose diffusely darker. I have seen specimens from Rajasthan, Gujarat, Maharashtra, Madhya Pradesh, Bihar, Bengal, the eastern Godavari in Andhra Pradesh, and Sandur in Karnataka.

Tetracerus quadricornis iodes Hodgson, 1847

1847 *Tetracerus iodes* Hodgson. Sal Forests of sub-Himalayan region.

1847 *Tetracerus paccerois* Hodgson. Same locality.

Similar in size, but with wider nasals; horns smaller. Colour variably fawn above, light fawn below, this tone often confined to a very narrow midline streak; foreleg with at most a vague, dark brown line, which may be interrupted at knee; median dorsal region not darkened. Nose diffusely darker. The four skins and skulls I have seen are from Nepal (3) and Champa (1).

Tetracerus quadricornis subquadricornis (Gray, 1843)

1839 *Antilope sub-4-cornutus* Elliot. Southern Mahratta country.

1843 *Tetracerus subquadricornis* Gray.

1847 *Teracerus subquadricornutus* Hodgson. Emendation of *sub-4-cornutus*.

Smaller in size, with very broad nasals; only a single pair of horns, which are rather long.

Colour varying from red-fawn to more olive above; underside whitish in midline, pale yellow laterally; foreleg line very vague or absent; median dorsal region slightly darkened; midline of nose may be sharply darker; tail short. The four male and two female skulls and 9 skins are from Palkonda Hills, Madras(= Chennai), Dharwar and Kuckanalla.

Genus *Procapra* Hodgson, 1846

Procapra picticaudata Hodgson, 1846. Tibetan gazelle or Goa

1846 *Procapra picticaudata* Hodgson. Hundes, Tibet.

Like yak, goa enter the Indian region in Ladakh. The species is monotypic.

Genus *Gazella* de Blainville, 1816

Gazella bennettii (Sykes, 1831). Chinkara or Indian gazelle

Groves (1993b) revised this species in Iran, and the accumulation of specimens from India now enables me to do the same for the species in the Subcontinent, including the description of a new subspecies. Apart from the three described subspecies, I have good-sized samples from two other regions, the Salt Range (including Punjab and Haryana) and the Ganga Valley, and I here describe the first of these as a new subspecies. Their measurements are given in Table 2.

Gazella bennettii bennettii (Sykes, 1831)

1831 *Antilope bennettii* Sykes. Deccan.

1843 *Antilope hazenna* I. Geoffroy St. Hilaire. Malwa.

Table 1: Differences in measurements of *Tetracerus quadricornis* subspecies

Measurements in mm ±SE (n)	<i>quadricornis</i>	<i>iodes</i>	<i>subquadricornis</i>
Skull length (male)	192.9 ±5.47 (11)	191.0 (1)	187.0 ±3.00 (3)
Nasal breadth (male)	17.2 ±1.38 (17)	18.7 ±2.52 (3)	19.7 ±1.15 (3)
Number of horns	4	4	2
Posterior horn length	90.7 ±10.61 (23)	73.5 ±4.73 (4)	83.5 ±13.18 (4)
Anterior horn length	48.6 ±3.78 (7) Rajasthan 31.7 ±11.31 (11) elsewhere	20.7 ±5.69 (3)	-

Table 2: Comparative measurements of *Gazella* spp.

Measurements in mm \pm SE (n)	<i>fuscifrons</i>	<i>salinarum</i>	<i>christyi</i>	Ganga Valley	Rajasthan	<i>bennettii</i>
Males:						
Horn length	247.2 \pm 23.9 (11)	283.5 \pm 16.1 (16)	284.3 \pm 19.1 (26)	256.1 \pm 33.2 (18)	269.8 \pm 25.4 (12)	253.0 \pm 12.7 (7)
Horn span	119.5 \pm 22.8 (11)	145.4 \pm 36.1 (14)	139.6 \pm 22.6 (26)	132.7 \pm 31.1 (17)	140.3 \pm 22.8 (12)	103.8 \pm 15.7 (6)
Bases of cores	62.1 \pm 4.59 (10)	66.1 \pm 2.75 (17)	64.5 \pm 2.34 (26)	64.6 \pm 3.88 (19)	62.8 \pm 1.63 (13)	62.6 \pm 5.32 (8)
Nasal breadth	24.0 \pm 1.22 (8)	24.3 \pm 1.28 (8)	22.1 \pm 1.93 (11)	22.5 \pm 1.69 (11)	22.8 \pm 0.92 (10)	21.0 \pm 2.00 (3)
Nasal length	51.3 \pm 4.62 (8)	56.8 \pm 3.28 (8)	54.1 \pm 4.85 (11)	55.4 \pm 5.36 (10)	52.2 \pm 4.46 (9)	50.7 \pm 4.04 (3)
Skull length	184.4 \pm 4.47 (7)	198.0 \pm 5.80 (6)	191.1 \pm 2.61 (7)	182.9 \pm 7.95 (7)	186.0 \pm 3.70 (8)	171.0 (2)
Biorbital breadth	83.8 \pm 2.18 (9)	87.2 \pm 1.91 (16)	85.5 \pm 2.14 (25)	84.9 \pm 3.77 (17)	84.8 \pm 2.45 (13)	80.8 \pm 1.94 (6)
Preorbital length	94.1 \pm 3.64 (8)	99.8 \pm 3.77 (8)	97.0 \pm 3.02 (8)	94.0 \pm 6.71 (9)	94.1 \pm 2.59 (8)	87.0 (2)
Toothrow length	56.9 \pm 1.27 (9)	57.6 \pm 2.84 (12)	56.0 \pm 3.57 (12)	55.9 \pm 3.09 (14)	57.0 \pm 2.52 (12)	54.8 \pm 2.59 (5)
Females:						
Horn length	175.4 \pm 38.4 (5)	136.0 \pm 29.5 (3)	118.0 \pm 23.5 (3)	119.2 \pm 21.2 (5)	130.5 \pm 12.0 (4)	110.0 (2)
Horn span	77.5 \pm 13.2 (4)	58 (1)	91 (1)	67.0 (2)	69.5 (2)	57 (1)
Bases of cores	52.4 \pm 2.92 (7)	51.7 \pm 1.53 (3)	50.4 \pm 1.34(5)	51.4 \pm 0.98 (7)	50.0 \pm 1.58 (5)	50.8 \pm 0.76 (3)
Nasal breadth	22.8 \pm 1.72 (6)	22.0 (2)	21 (1)	21.4 \pm 1.52 (5)	21.5 \pm 1.66 (5)	20.0 (2)
Nasal length	47.3 \pm 5.54 (6)	55.5 (2)	46.0 \pm 7.81 (3)	48.8 \pm 4.44 (5)	52.0 \pm 3.37 (4)	53.7 \pm 6.35 (3)
Skull length	179.4 \pm 5.37 (5)	191.5 (2)	184.0 (2)	181.0 \pm 7.71 (5)	182.8 \pm 3.49 (5)	172 (1)
Biorbital breadth	80.9 \pm 3.20 (6)	82.7 \pm 3.21 (4)	81.0 \pm 2.00 (4)	80.9 \pm 2.12 (7)	82.0 \pm 1.22 (5)	78.7 \pm 1.15 (3)
Preorbital length	92.7 \pm 4.79 (5)	102.5 (2)	95.5 (2)	93.3 \pm 4.55 (6)	95.6 \pm 3.36 (5)	89 (1)
Toothrow length	55.7 \pm 2.06 (7)	58.7 \pm 2.52 (3)	56.0 \pm 4.55*(4)	54.7 \pm 3.59 (7)	56.6 \pm 3.05 (5)	56.7 \pm 2.08 (3)

From Ganga Valley and its vicinity (Muttra, Gwalior, Jhansi, Etawah, Hamirpur, Allahabad, Rewa, Jabalpur, Nimar, Asirgarh, Palamau, Jagodih, Hazaribagh) and the Deccan (Hyderabad, Haturna, Indore, Bhopal, Khandesh). 14 skins, 3 head-skins, 41 full or partial skulls (including frontlets and horns). Head, neck, limbs and most of flanks dull reddish brown; median dorsal region and lower flanks (abutting the white underparts) are abruptly darker, tawny. Winter coat is distinctly longer than summer, but the colour does not differ. The Ganga Valley gazelles are of much larger skull size, with more widely spreading horns (but of equal size), than those of the Deccan, and it may be appropriate to separate them into two subspecies if further material from the Deccan confirms these trends; but the pelage characters are identical.

Gazella bennettii christyi Blyth, 1842

1842 *Gazella christii* Blyth. Thar Desert.

From Kutch and Saurashtra, as far east as Ahmedabad. 12 skins, 39 full or partial skulls (including frontlets and horns). Most skins are very pale, almost silvery drab brown with only very restricted median dorsal and lower flank zones being slightly darker than the rest of the body; a few are slightly richer, with more contrast. Winter coat hardly longer than summer. More sexually dimorphic than *Gazella bennettii bennettii*: male, but not female, is larger and longer-horned.

Gazella bennettii fuscifrons Blanford, 1873

1873 *Gazella fuscifrons* Blanford. Jalk, southeastern Iran.

From Baluchistan (Iran and Pakistan) to Sind and Rajasthan (Bikaner, Jodhpur, Jaisalmer). 16 skins, 36 full or partial skulls (including frontlets and horns). Colour in winter dark grayish sandy, often with a distinct brown band edging the white of the underparts but without much median dorsal darkening; in summer, brownish bay-fawn. Coat with very long hair in winter. Size

as in Ganga Valley population of *G.b. bennettii*, but with shorter, broader nasals, especially in males; males have shorter, more upright horns, but females have longer horns than any other subspecies in the Subcontinent. The cranial and horn metrics of Rajasthan specimens are nearly identical to those from Baluchistan and Sind, and pelage characters are the same.

Gazella bennettii salinarum s.s. nov.

Type: BM(NH) 25.10.3.5, skin and skull of adult female from Ara, Salt Range, 700 m above msl. Specimens seen: 3 skins, 1 head-skin, 17 male and 3 female skulls. Haripur, Pind Didan Khan, Faridkot (skins and skulls), "Punjab" (skull and head-skin), Barra Jandhi, Sirsa, Gurgaon, Rohtak, Hissar (skulls only). British Museum (Natural History), Museum Alexander Koenig (Bonn), Zoological Survey of India (Kolkata), Royal Scottish Museum (Edinburgh).

From the Salt Range east as far as Delhi.

Skin rich tobacco-brown, with no contrasting zone on the midback, but a contrasting flank band. The largest subspecies all round, in both sexes, with especially long nasals. Skull length in males is from 190 to 203 mm (only one specimen under 193); that of *G.b. christyi*, the next largest subspecies, is 187 to 195 mm (only one specimen above 193). Skull length in the two females is 186 and 197 mm; in both the two females of *G.b. christyi* it is 184 mm.

Gazella subgutturosa (Güldenstaedt, 1780).
Goitred gazelle

1780 *Antilope subgutturosa* Güldenstaedt.
Tbilisi, Georgia.

I have seen a herd from Pakistan in the private collection of Sheikhs Khalid and Hassan al-Thani at Al Wabra, near Doha, Qatar. They do not appear distinguishable in external characters from the nominotypical subspecies of the Iranian plateau, but this must remain a subjective judgement until specimens can be examined.

Genus *Antilope* Linnaeus, 1758

Antilope cervicapra (Linnaeus, 1758). Blackbuck

On geographic variation in this species, see Groves (1982). Dr. E.C. Mungall (pers. comm.) is examining the status of blackbuck from Point Calimere, which may represent a further subspecies, as yet undescribed.

Antilope cervicapra cervicapra (Linnaeus, 1758)

1758 *Capra cervicapra* Linnaeus. Inland of Trivandrum, restricted by Zukowsky, 1927).

1776 *Antilope rupicapra* Müller. Bengal.

1830 *Antilope bilineata* Gray. Bengal.

1843 *Cervicapra bezoartica* Gray. India.

1927 *Antilope hagenbecki* Zukowsky. Bengal.

From approximately east and south of the Delhi region, south to Chennai (earlier Madras) and Karnataka (Rannebenur) and to Vallanadu Reserve Forests in Tirunelveli district, and east to Bihar and Bengal. Smaller, with short fine hair; the dark colour runs all down the limbs to the hoofs, and the white eye-ring is narrowed above the eye. Horns are relatively short, not very divergent, and have a relatively open spiral.

Antilope cervicapra rajputanae Zukowsky, 1927

1927 *Antilope rajputanae* Zukowsky. Bahawalpur, borders of Rajasthan and Panjab.

1928 *Antilope centralis* Zukowsky. Gwalior.

From west of the Delhi region, to Saurashtra and Vadodara, Amritsar and into Pakistan. Larger, with longer, roughened pelage; the male in the breeding season has a grey sheen; the shanks are largely white, with little or no extension of the dark colour from the upper limb segments; the white eye-ring is broad all around the eye. Horns tend to be longer, more divergent and more closely spiralled.

Genus *Pantholops* Hodgson, 1834

Pantholops hodgsonii (Abel, 1826). Chiru

1826 *Antelope hodgsonii* Abel. Tingri Maidan, Arun Valley, Kooti Pass, Tibet.

1827 *Antilope kemas* Hamilton Smith. Central Asia.

1827 *Antilope chiru* Lesson. Nepal.

This species enters the Indian region in Ladakh; whether they have ever genuinely occurred in Nepal is unclear.

Genus *Ovis* Linnaeus, 1758

Ovis vignei Blyth, 1841. Urial

Geographic variation in this species is after Schaller (1977).

Ovis vignei vignei Blyth, 1841. Ladakh urial

1841 *Ovis vignei* Blyth. Astor, Kashmir.

1854 *Ovis montana* Cunningham. Ladakh.

From Ladakh; in Zanskar, it is sympatric with *O. ammon*. Horns of male thick, 230-260 mm in circumference, rise more steeply from the head and more corrugated than that of other urials, and tend to be supracervical (heteronymous), but sickle-shaped and homonymous occasionally occur. Colour brownish or greyish, with a grey saddle, occasionally with a dark line in front.

Ovis vignei punjabiensis Lydekker, 1913. Punjab urial

1913 *Ovis vignei punjabiensis* Lydekker. Salt Range, Punjab.

From the Salt and Kala Chitta Ranges, between the Indus and Jhelum rivers. Horns of male more slender (190-240 mm in circumference), sickle-shaped, with either tighter or looser curl. More reddish, with a two-coloured saddle patch (but this may be white only, or absent). The ruff, usually black in all urials, is occasionally white in this subspecies.

Ovis vignei cycloceros Hutton, 1842. Afghan urial

1842 *Ovis cycloceros* Hutton. Hazara Hills, near Kandahar, Afghanistan.

1877 *Ovis blanfordi* Hume. Hills above Bolan Pass, near Kelat, Baluchistan.

From Pakistan, west of the Indus, into Afghanistan. Horns of male 210-270 mm in circumference, usually homonymous. Reddish-buff to yellowish or light brown, with a small black saddle spot.

Ovis ammon Linnaeus, 1758. Argali

Geographic variation in this species follows Geist (1991).

Ovis ammon hodgsonii Blyth, 1841. Tibetan argali

1841 *Ovis hodgsonii* Blyth. Tibet, on Nepal frontier.

1841 *Ovis ammonoides* Hodgson. Himalayan region.

1852 *Caprovis bambhera* Gray. Nepal.

1874 *Ovis brookei* Ward. Ladakh.

In the Subcontinent extends into Ladakh, Sikkim and, formerly, Nepal. In mature rams, the long-haired, light-coloured ruff is sharply set off from the dark shoulders; rump patch distinctly set off dorsally, surrounds the tail; dark partial flank band, separating light belly from dark body; dark stripe from chest to hooves contrasts with light colour of rest of limbs. Face wholly dark in young, with light rostrum in old males. Horns of adult males have less developed combat edge (on external angle), less everted; of adult females long, thick, angular, usually about 450 mm long, occasionally up to 600 mm. Tail tiny, up to about 83 mm including hair, 58 mm without.

Ovis ammon polii Blyth, 1841. Pamir argali or Marco Polo's sheep

1841 *Ovis polii* Blyth. Near sources of Syr Darya, Pamir.

In the Subcontinent, extends to Hunza, Pakistan. Neck ruff of mature rams shorter, blends gradually with body tone; no sharp contrasts of pelage, grading between dark upper parts and white underparts and limbs; white of rump patch usually not sharply set off above, and continuous with an extensive white zone on thighs, hindlegs, underside and forelegs; flank stripe narrow, only

slightly darker than body, extends along flank and tops of limbs. Face light. Horns of adult males with well-developed combat edge, relatively thin, widely flaring, arise at a shallower angle; of ewes, relatively short and thin. Tail longer, 120-150 mm long including hair, 100 mm without.

Genus *Pseudois* Hodgson, 1846

Pseudois nayaur (Hodgson, 1833). Bharal or Blue sheep

1833 *Ovis nayaur* Hodgson. Tibetan frontier of Nepal.

1835 *Ovis nahoor* Hodgson. Alternative name.

1841 *Ovis burrhel* Blyth. Boorendo Pass.

Extends from the Karakoram eastward through Ladakh all along the Himalayan slopes from 3,500 to 5,500 m above msl (Schaller 1977).

Genus *Capra* Linnaeus, 1758

Capra sibirica (Pallas, 1776). Siberian ibex

Capra sibirica sakeen Blyth, 1842

1842 *Capra sakeen* Blyth. Tibetan slopes of Himalayas.

1844 *Aegoceros skyn* Wagner. Baltistan, Kashmir.

1886 *Capra dauvergnii* Sterndale. Hills north of Kishenganga river, Kashmir.

1900 *Capra sibirica wardi* Lydekker. Braldu, Baltistan, near Baltoro Glacier.

1906 *Capra sibirica pedri* Lorenz. Gilgit, Kashmir.

1911 *Capra sibirica filippii* Camerano. Lahul.

In the region, ibex are found on high, rocky cliffs, seldom below 3,000 m, from the Hindu Kush east only to the Sutlej river. Kashmir ibex resemble those from the Tianshan (*Capra sibirica alaiana*), and differ from those from the Altai (*C.s. sibirica*), in their large size and long nasal bones, and the large white saddle on the back, but differ in their shorter horns, and the failure of the saddle to extend to the haunches.

Capra aegagrus Erxleben, 1777. Bezoar goat

Capra aegagrus blythi Hume, 1875.

1875 *Capra blythi* Hume. Sind.

1913 *Capra falconeri chialtanensis* Lydekker.
Chiltan Range, near Quetta, Baluchistan.

Bezoar goats occur on the low desert ranges of Pakistan west of the Indus, both sympatric with markhor (as on the Murdar Range, near Quetta, and in the Gadabar Ghar Range, east of Loralai) and separately (south of about 30° N). On some of these ranges, along with the common scimitar-horned form, occur screw-horned *Capra*, called Chiltan goats by Schaller and Khan (1975). These were originally described as a subspecies of markhor by Lydekker (*Capra falconeri chialtanensis*), but their status has been queried and discussed by both Schaller and Khan (1975) and Roberts (1977).

According to Schaller and Khan (1975; see also Schaller 1977), Chiltan goats are found intermingled in the same herds as scimitar-horned goats in the Zahri, Koh-i-Maran and Dilband-Moro ranges and districts; as the only *Capra* on the Chiltan Range; and on the Murdar Range, where goat and markhor are sympatric.

Schaller and Khan (1975) consider that Chiltan goats are a polymorphic variant of *Capra aegagrus*. They note that the horns lack the markhor's posterior keel, and the cross-section is oval like a scimitar-horned bezoar's horn; there is no neck ruff; and the pelage resembles a bezoar. Where it coexists with scimitar-horned goats, the two are found intermingled in the same herds.

For Roberts (1977), however, the Chiltan goat is a hybrid between bezoar and markhor. The female resembles markhor, being reddish-grey with a dorsal stripe and creamy legs with a pattern on the front; but Roberts admits that bezoar can be reddish-grey as well, although they have a dark face pattern and the legs are greyer, less creamy. The male, he agrees, resembles bezoar more, becoming more and more grey-white

with age, and some have a black chest and shoulder-stripe like the bezoar. He says that there have been some local extinctions of bezoar or markhor, and implies that early in the 20th century the distribution of Chiltan goats encompassed all the ranges where bezoar and markhor were sympatric.

The type of *chialtanensis* is a frontlet with horns, but there is also a nearly complete skull of a Chiltan goat in the Natural History Museum (London), BM 67.795. This is as big as a markhor, and bigger than any bezoar, but has big teeth like a bezoar (Table 3). In my opinion, the Chiltan goat is most likely to be a hybrid.

Table 3: Comparison of Chiltan goat with markhor and with scimitar-horned bezoar

	Baluchi markhor	Chiltan goat	Largest bezoar
Biorbital breadth	145 mm	146	144 (usually 140)
Nasal length	89	88	82
Maxillary tooththrow	77	84	82

Capra falconeri (Wagner, 1839). Markhor
Geographic variation after Schaller and Khan (1975).

Capra falconeri falconeri (Wagner, 1839)
1839 *Aegoceros (Capra) falconeri* Wagner.
Kashmir (restricted to Astor by Lydekker, 1913).

1898 *Capra falconeri cashmiriensis* Lydekker.
Pir Panjal Range, Kashmir.

1958 *Capra falconeri chitralensis* Cobb. Chitral.

1958 *Capra falconeri gilgitensis* Cobb. Gilgit watershed. *Nomen nudum*.

From eastern Afghanistan east to Kashmir. Horns are more curved, wider across the tips; size is larger, and the coat is longer and silkier, with a well-developed neck ruff. The "Kashmir" horn type, moderately divergent and with 2 or 3 twists, occurs in Afghanistan, Chitral, Dir, and Swat, and again in Shamsberi, Kaj-i-Nag and Pir Panjal; the

more flaring, less twisted (1.5 turns) "Astor" type predominates in intervening localities.

Capra falconeri megaceros Hutton, 1842

1842 *Capra megaceros* Hutton. Kandahar, Afghanistan.

1875 *Capra jerdoni* Hume. Suleiman Range, Punjab, Pakistan.

From the northern hill ranges of Pakistan. Horns are less curved (more closely corkscrewed, less divergent; size is smaller, and the pelage is shorter, with (usually) no distinct ruff. Two horn types, the more open-spiralled Kabul type, and the more corkscrew Sulaiman type, occur together widely.

Genus *Hemitragus* Hodgson, 1841

Hemitragus jemlahicus (Hamilton Smith, 1826). Himalayan tahr

1826 *Capra jemlahica* Hamilton Smith. Jemla Hills, Nepal.

1833 *Capra jharal* Hodgson. Nepal.

1836 *Capra quadrimammis* Hodgson. Nepal.

1845 *Capra tuberculicornis* Schinz. Substitute for *jemlahica*.

1944 *Hemitragus jemlahicus schaeferi* Pohle. 10 km southwest of Chuntang, Sikkim.

The range, according to Schaller (1977), extends from about 40 km west of Banihal Pass, in the Pir Panjal, east into Bhutan, in cliff country where they migrate seasonally between forest and alpine zones.

Hemitragus hylocrius (Ogilby, 1838). Nilgiri tahr

1838 *Kemas hylocrius* Ogilby. Nilgiri Hills.

1842 *Capra (Ibex) warryato* Gray. Nilgiri Hills.

Found in the highlands of the Tamil Nadu/Kerala borderlands, presently surviving mainly in the Nilgiri Hills, High Range and Highway Mountains; in rolling country at 1,200 to 2,600 m above msl (Schaller 1977).

Genus *Capricornis* Ogilby, 1837

The taxonomy of this genus follows Grubb and Groves (in prep.). Himalayan serow are sharply distinct from those in China or Southeast Asia, and there is no merit in keeping them in the same species.

Capricornis thar (Hodgson, 1831). Himalayan serow

1831 *Antilope thar* Hodgson. Nepal Himalaya.

1832 *Antilope bubalina* Hodgson. Nepal.

1842 *Nemorhaedus* or *Kemas proclivus* or *thar* Hodgson. *Nomen nudum*.

1908 *Capricornis sumatraensis humei* Pocock. Kashmir.

1908 *Capricornis sumatraensis rodoni* Pocock. Chamba, Panjab.

1908 *Capricornis sumatraensis jamrachi* Pocock. Kalimpong, near Darjiling.

From Kashmir, almost at the Afghanistan border, east as far as the Lushai Hills, Assam. This species is black, with a buffy tone as the black tips wear off and reveal the lighter hair bases; a long mane, mixed black and white; below, sharply cream-buff; broadly white over nose, or only on lip margins; white extends backwards along jawlines in a 'V' shape, or interramal region completely white, or occasionally white tones are nearly absent; legs creamy-white from below knees and hocks.

An erythristic population (subspecies or separate species?) occurs in the Garo, Mishmi and Naga Hills. This is close to *C. thar* in its fairly long pelage, white hair-bases, and black and white mane; it is different from *Capricornis rubidus* of northern Burma, which differs in its very short pelage, the black (not white or buffy) hair-bases, the black dorsal stripe, and the very short dark red mane.

Genus *Nemorhaedus* Hamilton Smith, 1827

As in *Capricornis*, the taxonomy of this genus follows Grubb and Groves (in prep.).

Nemorhaedus goral (Hardwicke, 1825). Himalayan goral

Nemorhaedus goral goral (Hardwicke, 1825). Brown goral

1825 *Antilope goral* Hardwicke. Kathmandu.

1827 *Antilope duvaucelii* Hamilton Smith, 1827.

1908 *Naemorhedus hodgsoni* Pocock. Sikkim.

From Bhutan west to about Nainital. Medium brown with black hair tips, giving a hare-like effect; or slightly greyer, to grey-brown; or pale or dark fawn; legs browner, to very bright tan, or white on forelegs only. Underside paler grey. Throat and chin variably white, may be interrupted under jaw; lips white. Dorsal stripe usually weak, may fade behind withers.

Nemorhaedus goral bedfordi (Lydekker, 1905). Grey goral

1905 *Urotragus bedfordi* Lydekker. Dharmsala.

From Chamba and Kulu, west into Kashmir. Grey to grey-brown to yellow-grey; legs lighter, yellower, with dark brown line down front, fading on pasterns. Underside off-white. Throat and chin creamy the whole way. Merest trace (if that) of dorsal stripe.

Genus *Budorcas* Hodgson, 1850

Takin of India and Bhutan differ from those of China in their smaller horns and in the brown rather than golden colour, except for a lighter, yellow-toned saddle. They become blacker with age, this colour developing earliest on the underside, haunches and limbs.

Budorcas taxicolor Hodgson, 1850. Takin

Budorcas taxicolor taxicolor Hodgson, 1850

1850 *Budorcas taxicolor* Hodgson. Mishmi Hills.

Known from the Mishmi Hills (extending into Chinese and Burmese territory). Males much larger than females (biorbital breadth over 190 mm in males, less than 176 in females); teeth relatively small, maxillary tooththrow length 114-122 mm; horns of males very large, their span 341-411 mm.

Budorcas taxicolor whitei Lydekker, 1907

1907 *Budorcas taxicolor whitei* Lydekker. Bhutan.

From Sikkim and Bhutan. Males as small as females (biorbital breadth 166-182 mm in both sexes); maxillary tooththrow length 120-124 mm; horns of males smaller, their span 297-357 mm.

REFERENCES

- CHOU DHURY, A. (1997): Checklist of the Mammals of Assam. Gibbon Books and Assam Science Technology and Environment Council, Guwahati. 103 pp.
- DERANIYAGALA, P.E.P. (1939): Some aspects of the Asiatic elephant in zoology and ethnography. *J. Roy. Asiat. Soc. (Ceylon)* 34(91): 126-162.
- DERANIYAGALA, P.E.P. (1955): Some extinct elephants, their relatives and the two living species. National Museums of Ceylon, Colombo. 153 pp.
- DOLAN, J.M. (1988): A deer of many lands – a guide to the subspecies of the red deer *Cervus elaphus* L. *ZooNooz* 62(10): 4-34.
- GEIST, V. (1991): On the taxonomy of giant sheep (*Ovis ammon* Linnaeus, 1766). *Canadian Journal of Zoology* 69: 706-723.
- GEIST, V. (1998): Deer of the World: their Evolution, Behavior, and Ecology. Stackpole Books, Mechanicsburg, PA, USA.
- GHOSH, M. (1988): The craniology and dentition in the pigmy hog, with a note on the generic status of *Porcula* Hodgson, 1847. *Rec. zool. Surv. India* 85: 245-266.
- GOODMAN, M., C.A. PORTER, J. CZELUSNIAK, S.L. PAGE, H. SCHNEIDER, J. SHOSHANI, G. GUNNELL & C.P. GROVES (1998): Toward a phylogenetic classification of Primates based on DNA evidence complemented by fossil evidence. *Mol. Phyl. Evol.* 9: 585-598.
- GROVES, C.P. (1967): On the rhinoceroses of Southeast Asia. *Säugetierkundl. Mitt.* 15: 221-237.
- GROVES, C.P. (1981): Ancestors for the Pigs: taxonomy and phylogeny of the genus. *Sus*. Technical Bulletin No. 3, Department of Prehistory, Research School

- of Pacific Studies, Australian National University.
- GROVES, C.P. (1982): A note on geographic variation in the Indian Blackbuck (*Antilope cervicapra* Linnaeus, 1758). *Rec. zool. Surv. India* 79: 489-503.
- GROVES, C.P. (1983): Geographic variation in the barasingha or swamp deer (*Cervus duvauceli*). *J. Bombay nat. Hist. Soc.* 79: 620-629.
- GROVES, C.P. (1993a): Testing rhinoceros subspecies by multivariate analysis. Pp. 92-100. *In: Rhinoceros Biology and Conservation* (Ed.: Ryder, O.A.). Zoological Society of San Diego, San Diego.
- GROVES, C.P. (1993b): The chinkara (*Gazella bennetti*) in Iran, with the description of two new subspecies. *J. Sci. I. R. Iran* 4: 166-178.
- GROVES, C.P. (1996): The taxonomy of the Asian wild buffalo from the Asian mainland. *Z. f. Säugetierkunde* 61: 327-338.
- GROVES, C.P. (2001): *Primate Taxonomy*. Smithsonian Institution Press, Washington, D.C. vii + 350 pp.
- GROVES, C.P. & S. CHAKRABORTY (1983): The Calcutta collection of Asian rhinoceros. *Rec. zool. Surv. India* 80: 251-263.
- GROVES, C.P. & P. GRUBB (1987): Relationships of living deer. Pp. 21-59. *In: Biology and Management of the Cervidae* (Ed.: Wemmer, C.M.). Smithsonian Institution Press, Washington, D.C.
- GROVES, C.P. & P. GRUBB (1990): Muntiacidae. Pp. 134-168. *In: Horns, Pronghorns and Antlers* (Eds.: Bubenik, G.A. & A.B. Bubenik). Springer Verlag, New York.
- GROVES, C.P. & V. MAZÁK (1967): On some taxonomic problems of Asiatic wild asses with a description of a new subspecies (*Perissodactyla*, *Equidae*). *Z. f. Säugetierkunde* 32: 321-355.
- GROVES, C.P., Y. WANG & P. GRUBB (1995): Taxonomy of musk-deer, genus *Moschus* (*Moschidae*, *Mammalia*). *Acta Theriol. Sin.* 15: 181-197.
- GRUBB, P. (1982): The systematics of Sino-Himalayan musk deer (*Moschus*), with particular reference to the species described by B.H. Hodgson. *Säugetierkundl. Mitt.* 30: 127-135.
- GRUBB, P. (1990): Cervidae of South Asia. Pp. 169-179. *In: Horns, Pronghorns and Antlers* (Eds.: Bubenik, G.A. & A.B. Bubenik). Springer Verlag, New York.
- INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE (1985): Opinion 1348: *Bos gaurus* H. Smith, 1827 (*Mammalia*, *Artiodactyla*): conserved. *Bull. Zool. Nomen.* 42: 279-280.
- KNOX, R. (1681): *An Historical Relation of the Island Ceylon in the East Indies*. Reprinted 1983, Navrang, New Delhi.
- POCOCK, R.I. (1943a): The larger deer of British India. Part III. The Sambar (*Rusa*). *J. Bombay nat. Hist. Soc.* 44: 27-37.
- POCOCK, R.I. (1943b): The larger deer of British India. Part IV. The Chital (*Axis*) and the Hog-deer (*Hyelaphus*). *J. Bombay nat. Hist. Soc.* 44: 169-178.
- ROBERTS, T.J. (1977): *The Mammals of Pakistan*. Ernest Benn Ltd, London. 361 pp.
- ROOKMAAKER, L.C. (1980): The distribution of the rhinoceros in eastern India, Bangladesh, China and the Indo-Chinese region. *Zool. Anz.* 205: 253-268.
- ROOKMAAKER, L.C. (1983): Historical notes on the taxonomy and nomenclature of the recent *Rhinocerotidae* (*Mammalia*, *Perissodactyla*). *Beaufortia* 33: 37-51.
- ROOKMAAKER, L.C. (1998): The sources of Linnaeus on the Rhinoceros. *Svensk. Linnésällsk.s årssk., Uppsala 1996-1997*: 61-80.
- ROOKMAAKER, L.C. (2000): Records of the rhinoceros in Pakistan and Afghanistan. *Pakistan J. Zool.* 32: 65-74.
- SCHALLER, G.B. (1977): *Mountain Monarchs: Wild Sheep and Goats of the Himalaya*. Chicago University Press, Chicago. xviii + 425 pp.
- SCHALLER, G.B. & S. KHAN (1975): The status and distribution of markhor (*Capra falconeri*). *Biol. Conserv.* 7: 185-198.

